Databases and MongoDB

This is the code we are going to understand in this class -> Week 7

In a full stack

there are basically 3 components

1. Frontend

2. a fleet of Backend Server -> so that if one crashes your website is still be able to operate,

- this should be **Stateless**

3. Database You do have multiple / fleet of database server but you dont expand them too fast as that cost too much to operate them

💡 **Why dont we let the user hit the database directly ??**

💡 **What extra does the http server provide exactly ??**

- Databases were are created using **protocols** that browser dont understand
- Databases dont have granual access as a first class citizen. Very hard to do user specific access in them
    - **Granual access** -> ex. is whosever has access to the password has access to all the things in the database. **Browser has access to the whole thing or Nothing** to **Restrict** the data we use **Backend Server**
- There are some databases (**firebase**)[works both as Server and Database] that let you get rid of http server and try their best to provide the granula access.

Try - Catch

Throwing and Catching errors in JS

💡 **What is the necessity of Try - catch block ??**

suppose you write the code like this

```
function  getLength(name) {
    return name.length;

}
const ans = getLength(); // as you have not passed anything so undefined is
actually passed which will eventually lead to Error
console.log(ans);

console.log("hi there") // The control will NEVER reach here so you should handle
it correctly

// But you might want the program to still continue, That is where TRY CATCH block
comes in action
```

If you know a particular codebase can throw an error then you must wrap it in TRY CATCH

💡 **How to know a particular codebase can throw an error ??**

-> with experience and most important some function you know that they can throw error thats where `try - catch` comes in action

```
try {
    let a;
    console.log(a.length); // If there is an error in this line then ALL the below line will get IGNORED and the control will directly reach to the error block
    console.log("from the try block")
} catch (error) {
    console.log("from the error block") // jaise he error aaya control error block ko execute krna start kr dega
}

console.log("hi there") // YE TO CHLEGA HE CHLEGA No matter whatever the error is as you have handled the error using the try - catch block
```

MongoDB and NoSQL databases

NoSQL database are a broad category of database systems that diverge from the traditional model used in SQL databases.

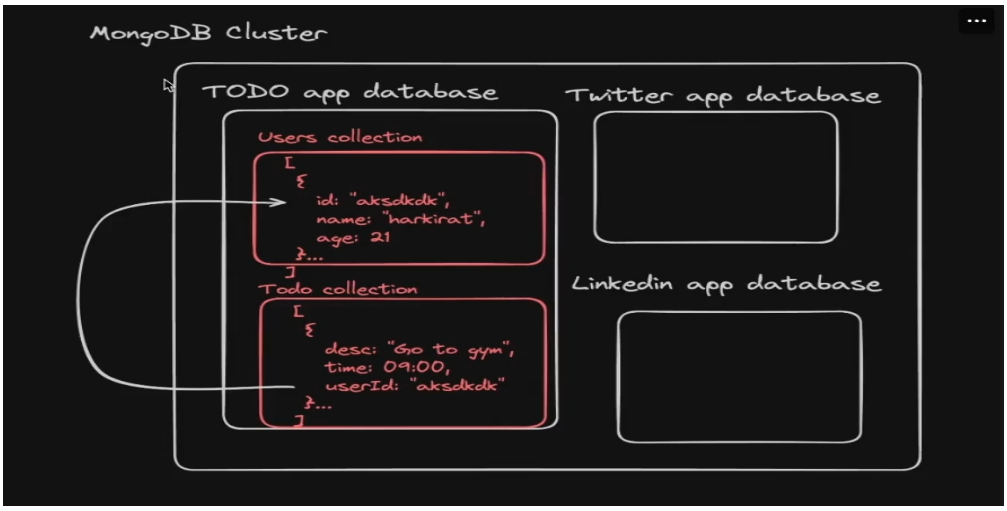
They are designed to handle a variety of data models and workloads that may not fit neatly into the tabular scheme of relational databases.

Properties / Features of NoSQL database:-

- **Schema flexiblity** -> NoSQL databases often allows for a flexible **scheme**(**How does you end data look like in database**),meaning you can store data in formats that dont require a fixed structure.
    - MongoDB is **SchemaLess**
- **Scaliblity** -> Many NoSQL databases are designed out to scale out horizontally(increase the number of instances), making it easier to distribute data across multiple servers and handle large volumes of traffic.

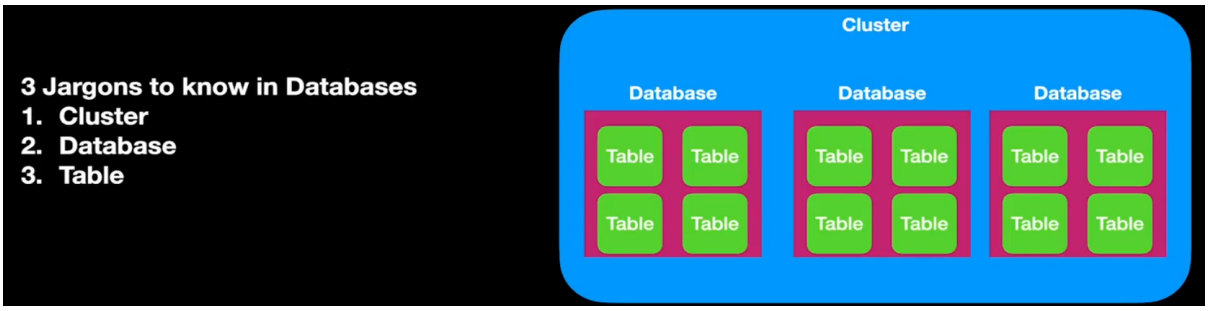
MongoDB

MongoDb is a NoSQL database that uses a **document-oriented approach**. Data is stored in flexible, JSON like documents, which can have nested structures and varied fields.

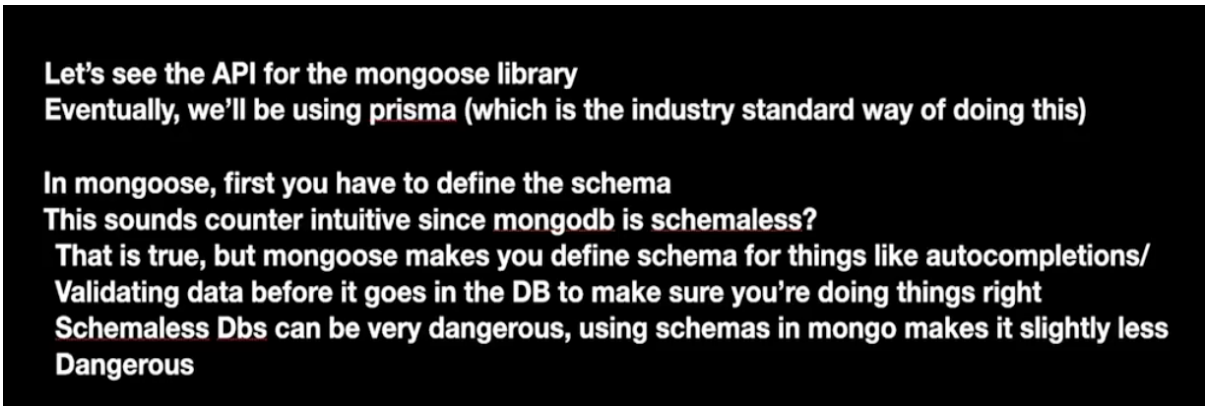


What is a cluster ??

-> A bunch of machines / database that are holding our data is what called as cluster of machine.

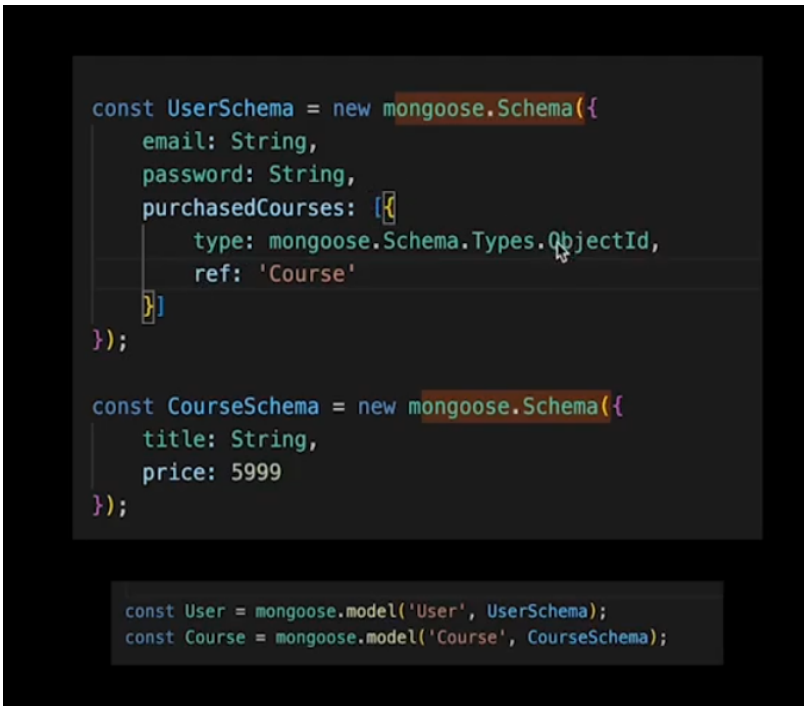


You can see in the picture that from the users database we have connected one or more app thus saving the space

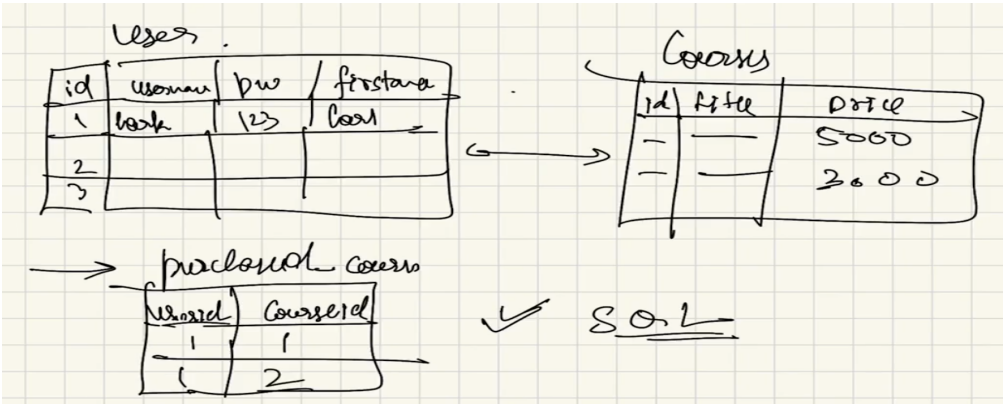


> ⚠️ `mongoDB` is schemaless but `mongoose` makes it schema

Defining Schema in database



Notice above `ref : course` also knwon as **Relationships in MongoDb** (This is the biggest advantage of NoSQL database, In SQL **there is a very ugly way to do this**) but in mongoDb, you can easily do this



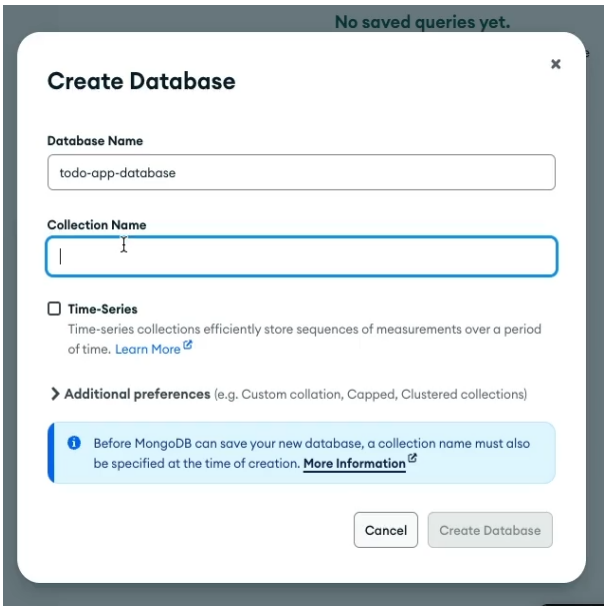
Notice for finding which user has bought which i have to make a whole other table called as `purchased_course` where corresponding to `user_id`, `course_id` exists (only 1 property `id` is enough to get all the info to the user) is stored

Sending data in MongoDB

Lets say you want add these things in MongoDB Image

The way to do that

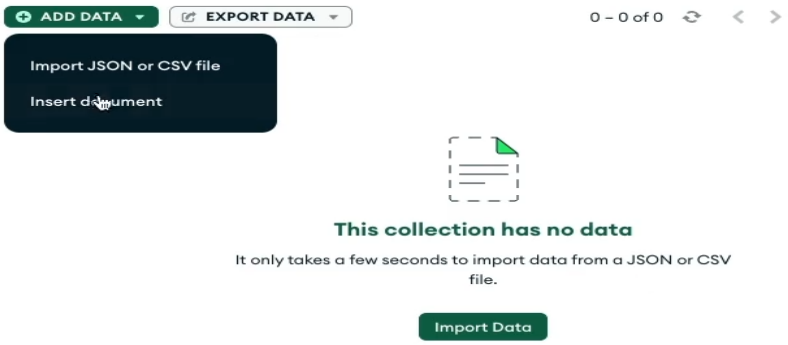
Step 1 -> Add the New database by clicking on the "+" icon in `compass` and then you will see something like this



as we are making database for To-Do app so give the `Database name` -> `todo-app-database`

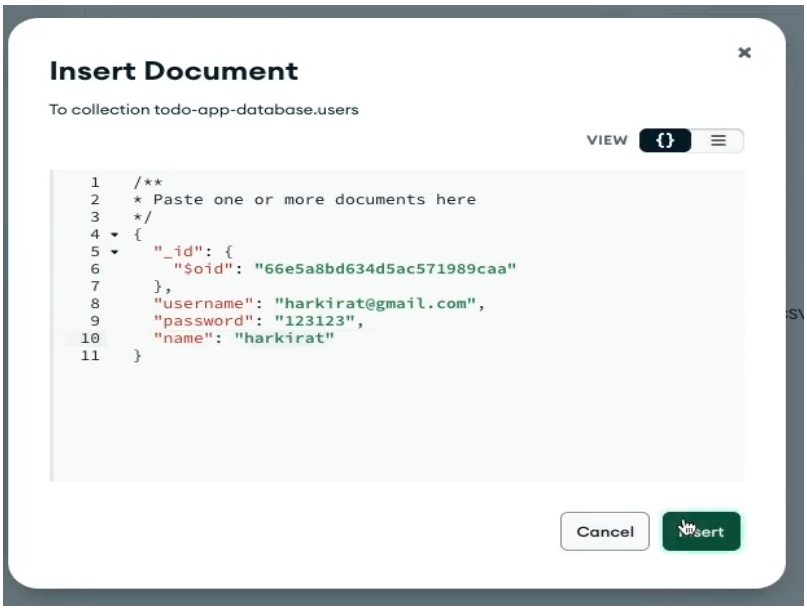
Now looking into the figure, we can clearly see it has two collections -> `users` and `Todo` so write them in in the `collection name` field

now **To add the data ->**



once you press insert document, you will see `id` (**auto - generated by the mongoDB**)

> 📌 **whenever you are in mongoDb,and you are creating a document, every document needs to have a UNIQUE ID**



Manually **ADD** the data like the above in `users` collection for **1st user**

similarly for `todos` collection `ADDED` manually the data

```
_id: ObjectId('66e5a91a634d5ac571989cac')
description: "go to gym"
done: false
userId: ObjectId('66e5a8bd634d5ac571989caa')
```

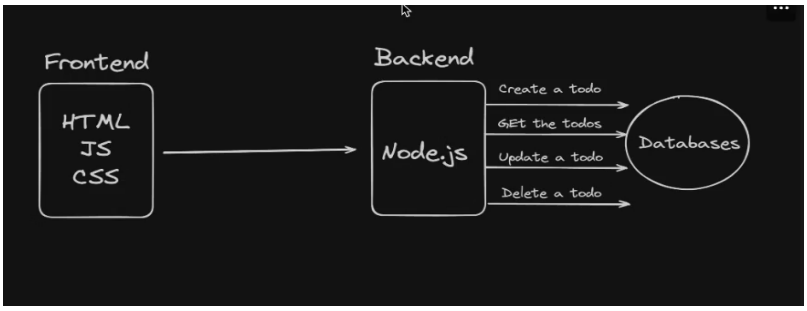
> ⚠️ Notice the userId it the of the one used in `users` collection for 1st user
>
> > Reason -> **Remember to have relation between the two or more collection you must have a userID UNIQUE which can be used to show relation between the two collection**
> >
> > > **You can assume it a Primary key in MySQL**

But we will not manually add when it comes to the full stack data this is the difference

CRUD Operations

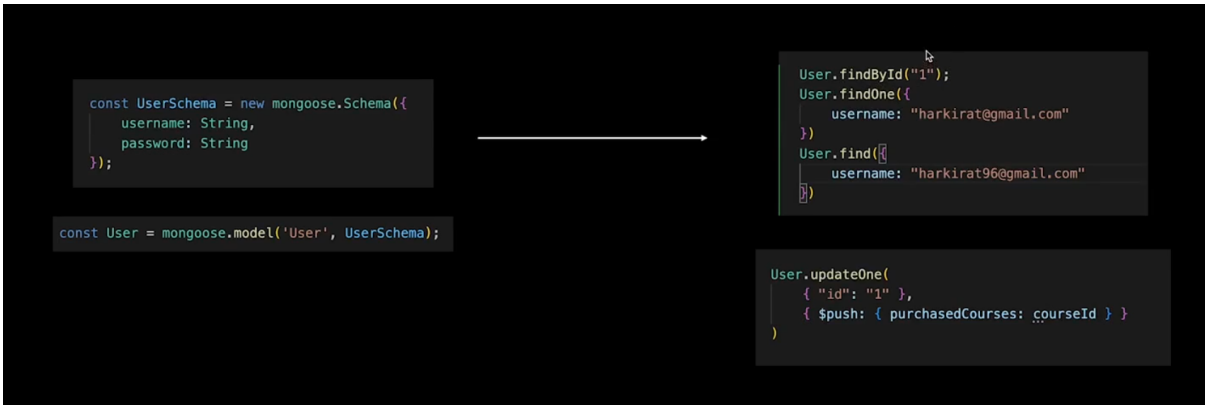
CRUD operations in MongoDB refers to the basic operations you can perform on documents within a MongoDB database. CRUD stands for :-

1. **Create ->** Adding new documents to the collection
2. **Read ->** Retrieving data from the collection
3. **Update ->** Modifying existing documents in a collection
4. **Delete ->** Removing documents from the collection



Create

Read



Difference between `.find()` and `.findOne()`

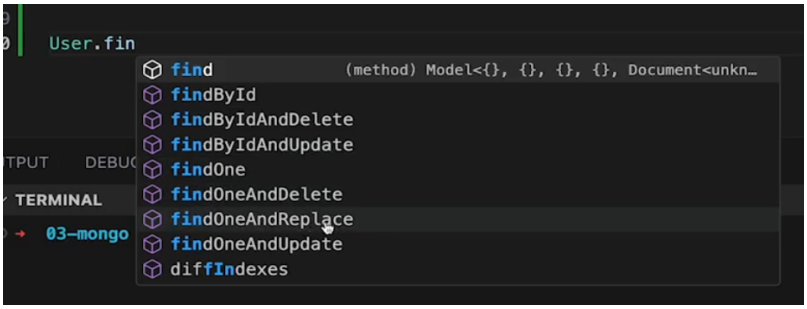
`.findOne` -> finds for **ONE** entry for that property (here `username`)

`.find` -> finds for **ALL** the entry for that property in the database (here `username`)

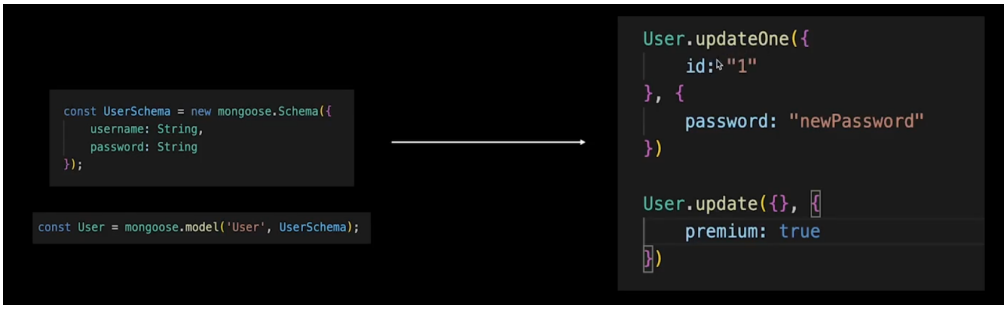
> ⚠️ **Remember** `.find` will **Return something** **Returns EMPTY ARRAY** if it does not `find` anything with the given thing in the Database, but `.findOne` will give **ERROR** if it does not find that **specific only data** in the database.
>
> > The above point is **Very - Very Important when comes to finding in the password** as while signing in, you will see that **after finding in the database**, You can only return **TOKEN** when the given username and password is valid, now in `.find` you will always recieve token [as response has came althought that is empty array but still response came, even though you have given wrong password] as it will return empty array (if it does not find that particular combination of password and username) and `jwt` considers as a response so it will **Generate token** but `.findOne` will find for that particular combination of password and username and if

> not present then return **error** which will hint `jwt` to **generate token** in this case and hence will not generate it
>
> > So **Always try to use** `.findOne` especially when returning `jwt` token

There are many functions related to `find`



Update



difference between `updateOne` and `update` is same as `find` and `findOne` and that is

see example :-

```
User.update({}, {
    premium : true,
})
```

this will give the **ACCESS to the Premium to EVERY user present in the Database**

Delete

> ⚠ `deleteMany({})` **will delete everything in the database SO NEVER USE IT**

Creating a backend of a ToDo app

Lets now create a `todo app` with the data being persisted in the `database`

Before going to actual project implementation first explore about `mongoose`

`mongoose` -> similar to `express.js`(used for creating http server), `mongoose` is a popular library to connect to the `MongoDB`

Installing the mongoose

```
const mongoose = require("mongoose")
OR
import mongoose from 'mongoose'
```

connecting to MongoDb

```
await mongoose.connect('mongoURI/database_name')

mongoURI -> the url mongoDb gave you to connect to the mongoDb
database_name -> which database you want to connect to ??
```

Defining a model

show me how you model / schema looks like

```
const Schema = mongoose.Schema
const ObjectId = mongoose.ObjectId

const BlogPost = new Schema({
    author : ObjectId,
    title : String,
    body : String,
    date : Date
});

What data are you trying to put in the database ??
```

coming back to the creation of backend of a todo app

Step 1 ->

initialise a new node.js project

Step 2 -> Install dependencies

```
npm install express mongoose
```

Step 3 -> create 4 skeleton for 4 routes in `index.js` made

- POST / **signup**
- POST / **Login**
- POST / **todo (authenticated)**
- GET / **todos (authenticated)**

```
app.post("/signup", (req, res) => {

})

app.post("/login", (req, res) => {

})

app.post("/todo", (req, res) => { // to create the todo

})

app.get("/todos", (req, res) => { // get all the todos of the user

})
```

Step 4 -> Add the database logic in the seperate file (name it as `db.js`)

`Database` has mainly **2 Parts** ->

- **Schema** -> Structure of the table
- **Model** -> where it belongs to ??

-> you could have put all the database logic in `index.js` but to **Structure our file system** it is advised to do like this

now in `db.js`

```
const mongoose = require("mongoose")
```

Step 5 -> start creating the **schema** of your table in the file `db.js`

```
const mongoose = require("mongoose")
const Schema = mongoose.Schema; // mongoose exports the CLASS called Schema that
defines the schema of the user
const ObjectId = mongoose.ObjectId; // To import ObjectId from mongoose

// defining the user schema (means user table me KYA JAYEGA with their datatype
??)
```

```
const User = new Schema({
    email : String, // easy version of the email
    email : {type : String, unique : true}, // hard verion with the check that
email should be UNIQUE
    password : String,
    name : String
})

// similarly defining the todo schema (means todo table me KYA JAYEGA)

const Todo = new Schema({
    userId : ObjectId, // userId was not String type it was of ObjectId type
    title : String,
    done : Boolean
})

const UserModel = mongoose.model('users', User); // 2
const TodoModel = mongoose.model("todos", Todo);

module.exports = { // 3
    UserModel,
    TodoModel
}
```

Explanation of `// 2` code

Now eventually you want some functions that help me to do `CRUD` operations in the database via the `index.js`

for this we use

about `mongoose.model()`

-> **helps to insert data in a particular collection with particular schema**

takes **2 arguments**

1. **Where the data is to be stored ??**
    - in our case, it should be in `users` collection
2. **and What schema does the data should follow to be able to save in this ??**
    - in our case, it should follow schema defined in `User` variable

💡 **We studied above that mongoDb is Schemaless yet we are defining the schema, Why ??**

Reason -> if we have used `mongodb` library then there we may have inserted any type of data but here we are using `mongoose` which pushes you to **give the schema** that's why we are defining the schema.

Also `mongoose` also allow you to put some random data in it but it urges you to put data in Schema form so that its library can be best used

> 📌 `mongoDb` is still schemaless we are **trying to decrease the chance of getting the `node.js` error or other error by defining STRICT schema through `mongoose`**

Explanation of `// 3` code

Now as we are working with the **seperate files** so to make them use **Interchangibly** **One must export them** and thats how you use them in another file

To import it in the `index.js`

```
const { UserModel, TodoModel } = require("./db")
```

Step 6 -> Implement the `sign up` function

```
app.post("/signup", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
    const username = req.body.username

    await UserModel.create({ // 2
        email : email,
        password : password,
        name : username,
    })

    res.json({
        message : " You are signed up "
    })
})
```

Explanation of `// 2` code

about `Model.create()` (do the CREATE part of the db)

-> **helps to Insert the data into the database in a particular schema**

> 💡 **Why you used async await ??**
>
> > **Reason -> Always Remember Database is in another country it will take some time**
> >
> > > as `await` was used lead to the use of `async`

Step 7 -> Implement the `login` function

```
app.post("/login", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
```

```
    // previosuly when using the array to store, we were finding whether the user
exists or not using the inbuilt find() function or loop
    const user = await UserModel.find({ // 2
        email : email,
        password : password
    })

    // again the same part as Authentication if the user is found in the database
then Generate a TOKEN
    if(user){
        const token = jwt.sign({
            id : user._id // previosuly we were using username as way to create
token but now as ID is the most unique thing which exists in the db so used that
            // Notice i have written ._id not .id as if you see in the collection
any document (._id) {auto generated by the mongoDb} is the way to identify the
user
        }, JWT_SECRET)
        res.status(200).json({
            token : token,
            message : "You are logged In"
        })

    }else{
        res.status(403).json({
            message : "Incorrect Credentials",
        })
    }
})
```

Explanation of `// 2` code

about `Model.find()` (do the READ part of db)

Insert as many as you want in `json` format and it will return only if all the fields given in `json` format **matches with any user**

-> also as we are fetching something fromt the database and it is very far so it will take time **hence wrap it in async and await**

> ⚠️ Dont use `Model.find()` as see in this file only difference between `.find()` and `.findOne()` and **Why you should use always `.findOne()`**

Very Very Important point

You also have to connect to the database as your code does not know **Where you mongoDb database is ??**

so for that add this in `index.js`

```
mongoose.connect(mongoURI/database_name)
```

here database_name is "todo-app-database" see this pic -> image 2

> 📌 Even if you give the wrong database name, It will **make a new Database with this name and enter the data there**

about `Model.update()`(do the UPDATE part of db)

> ⚠️ again you should use `.updateOne()` instead of using `.update()` **Reason behind it is same as that in `.find()` and `.findOne()`**

`.updateOne()` takes 3 arguments as paramter :-

1. **filter ->** kaun si **ROW** ko change krna chahte ho or simply saying **Kahan pe jake change krna h ??**
2. **change -> Kya kya field change krna h ??**
3. **options -> Read it by yourself although not important**

for example :-

```
const uptitle = req.body.title
const updescription = req.body.description
const upprice = req.body.price
const upimageUrl = req.body.imageUrl
const upcourseId = req.body.courseId

const course = await CourseModel.updateOne({
    _id : courseId // jahan par db me _id ka value courseId se match kr jaye
}, {
    title : uptitle // wahan par ke ye sb field me naye jo up se start hote h jo
user se liya h wo daal ya naye wale se change kr do
    description : updescription,
    imageUrl : upimageUrl,
    price : upprice
}) // There should be 3rd argument but generally it is not required
```

> ⚠️ again you should use `.updateOne()` instead of using `.update()` **Reason behind it is same as that in `.find()` and `.findOne()`**

Step 8 -> for the next two routes we need to apply **Authentication** as those who have `signup` and `login` they should only have **access to create the todo or read it**

so implementing the **Auth Middleware** for the above case

```
function authMiddleware(req, res, next){
    const token = req.headers.token;

    const decodedData = jwt.verify(token, JWT_SECRET);

    if(decodedData){
        req.userId = decodedData.id; // id present inside the token passed to the
```

```
other function that this is the id of the user whom something they want to do
        next()
    }else{
        res.status(403).json({
            message : "Incorrect Credentials or Secret Key",
        })
    }
}
```

Step 9 -> Implement the `todo` route

```
app.post("/todo", authMiddleware,async(req, res) => {
    const userId = req.userId;
    const title = req.body.title;
    const done = req.body.done;
    await TodoModel.create({
        userId,
        title,
        done
    })

    res.json({
        message : "To Do created"
    })

})
```

Step 9 -> Implement the `todos` route

```
app.get("/todos",authMiddleware, async (req, res) => {
    const userId = req.userId;
    const todothing = await TodoModel.find({
        userId
    })

    res.json({
        todothing : todothing,
    })

})
```

The whole code is also present on the Week 7 folder see the link at the TOP of this file

Improvements which can be made in the above project

1. Password is not hashed
2. A single crash (duplicate email) crashes the whole app
3. Add more endpoints (mark todos as done)

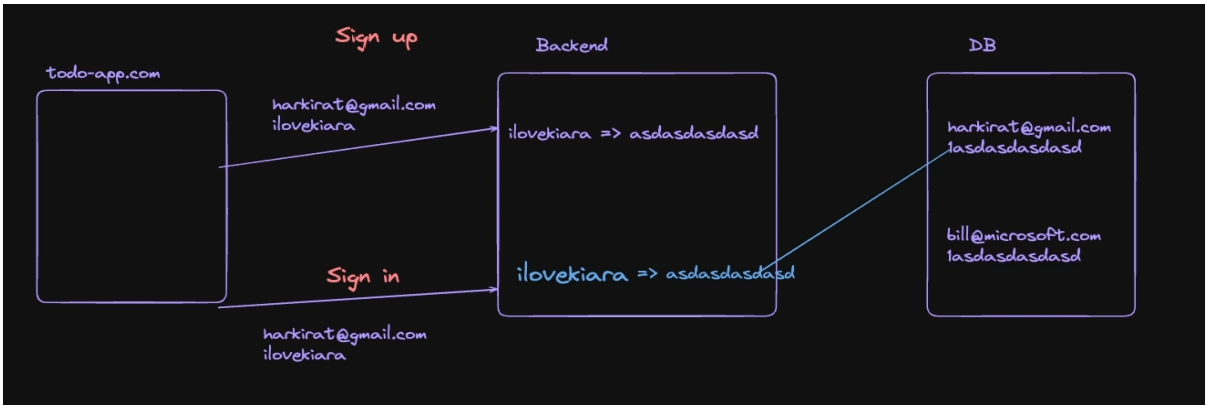
4. Add timestamps at which todo was created / the time it needs to be done by
5. Relationships in mongo
6. Add validations to ensure email and password are correct form

Passwords and ZOD

Need for Password Hashing

The main reason for password hashing is that if you store the password in plain text in the database

- **then anyone can relate to the password and can use it to get the user id and password**
- **If database gets leaked then everyone plain text data will get leaked to the whole world**
- some companies database has been hacked -> BigBasket, Paytm, Unacademy



When `sign up`

- before storing in the database, backend will `HASH` the password and then this `hashed password` gets stored in the database.

Now 💡 **How will the password is again matched??**

as you have `hashed` the password but the user does not know, he / she will send you the password in plain text only while `sign in` then **How will you match ??** -> By using the **same algorithm used while hashing again** apply that same algorithm again and then match (as the password will now change to hashed password) [Compare then with that stored in the password]

BUT

Again here is Problem can you guess ??

see the figure above You can see that the `hashed password` of `harkirat@gmail.com` & `bill@microsoft.com` in the **Database** are **SAME** what does this means -> **It simply means that BOTH have kept same password** so if one knows the password of `harkirat@gmail.com` then he / she will also be able to know the other person `bill@microsoft.com` and many other accounts password.

To solve the above problem

we do **Salting**

Salting

When you have a very big amount of Sabji being prepared, You add **very small amount of salt at regular interval**

In context of the above, salting in password means

when someone will come up to `sign up` the user (harkirat@gmail.com) will give some password (123123) now **i will add one more thing with it known as SALT**

> 📌 `salt` is **basically randomally generated strings**

And the mixture of `password + salt` will be now `HASHED` and in the Database we will now store

- **Hashed password**
- **Salt (but in plane text)**

Now if another user comes like bill@microsoft.com and keeps the same password (123123) due to the **salt** (as randomly generated), the mixture of these when `hashed` will be **different** from those **generated while** harkirat@gmail.com and now when this password will be stored in the database with the salt.

Even though if someone sees the password he / she will see two different password for the two users (although they have kept same password)

💡 How will the `sign in` process work for the above thing ??

while signing in, the backend will first take out the `salt` from the corresponding the user trying to login and then it willl add with the given password while signing in with `salt` and then again run the **hashing algorithm and match with that present in the database**

You can see the above figure used

💡 How to implement the above logic ??

You can do it by yourself by

- for `hashing` -> use common algorithms such as `SHA-256` or any other
- for `salting` -> you know how to generate the random string using `js` (its up to your logic how to generate that)

OR

use a libraray known as `bcrypt`

Hashing Password

This is the solution to the **1st Improvement** of the ones written in **Improvements which can be made in the above project**

💡 **Why should you use hash passwords ??**

Password hashing is a technique used to securely store passwords in a way that makes them difficult to recover or misuse. Instead of storing the actual password, you have a hashed version of it

about `bcrypt`

Bcrypt -> It is a `cryptographic hashing algorithm` designed for securely hashing passwords. Developed by Neils Provos and David Mazieres in 1999, `bcrypt` incorporates a `salt` and is designed to be computationally expensive, making brute-force approach **TOUGHER**

Installing it

```
npm install bcrypt
```

go to the library of it as it will be helpful -> Bcrypt

Using it

```
const bcrypt = require("bcrypt")
```

Now to use it, it have some defined functions to generate the string

Technique 1 -> (Generate a salt and hash on seperate function calls)

```
bcrypt.genSalt(saltRounds, function(err, salt) {
    bcrypt.hash(myPlaintextPassword, salt, function(err, hash) {
        // Store hash in your password DB.
    });
});
```

about `bcrypt.gensalt()`

syntax is similar to the `fs.readfile()`

takes 2 Arguments :-

1. **saltRounds ->** Its actually the variable name (you can take it anything) which has some `number`. **Higher the value of this variable higher times the hashing will occur to generate the salts**
    - `k` saltrounds undergo `2^k` iteration to generate salt

> 📌 **Ideally take it min - 3 and max - 15**

2. **Callback function ->** again takes 2 parameter as input :-
    - `err` -> what to do if `error` occurs ??
    - `salt` -> `salt` generated by the function to hash password

about `bcrypt.hash()`

-> used to **Hash the password**

takes 3 arguments (its common sense to guess these 3) :-

1. **Password (in plain text)** -> password bhejo plain text me as for `hashing`, you first need password
2. **salt** -> you have to add the salt also with the password and then only `hash` at last
3. **callback function** -> What are you going to do after the password is hashed ??

Technique 2 -> auto-gen a salt and then hash (**BETTER ONE**) [**Promisified version of the above technique**]

```
bcrypt.hash(myPlaintextPassword, saltRounds, function(err, hash) { // 1
    // Store hash in your password DB.
});

OR

const hashedPassword = await bcrypt.hash(myPlaintextPassword, saltRounds) // 2
```

This is more cleaner way of writing the above code as here you dont have to **first generate the `salt` and then add it and then at last `hash` it**

You can all do this in the same function

difference between both the function is that in one of them we have passed `salt` in `.hash()` as parameter and in other as `salt` is being auto-generated so just passed `saltRounds` (number of times the salt will be hashed continuously) as the parameer in `.hash()` function

you can also generate you own or write your own **function** to **generate** `salt`

Explantion of `// 2` code

we have just done the same thing as that done in `// 1` just here as `bcrypt.hash()` but instead of storing the output in `hash` and then **returning it** via the **callback function**, we are using a variable to **store the hashed password given as output**

> ⚠️ `bcrypt.hash()` returns a **Promise** so always use `await` here

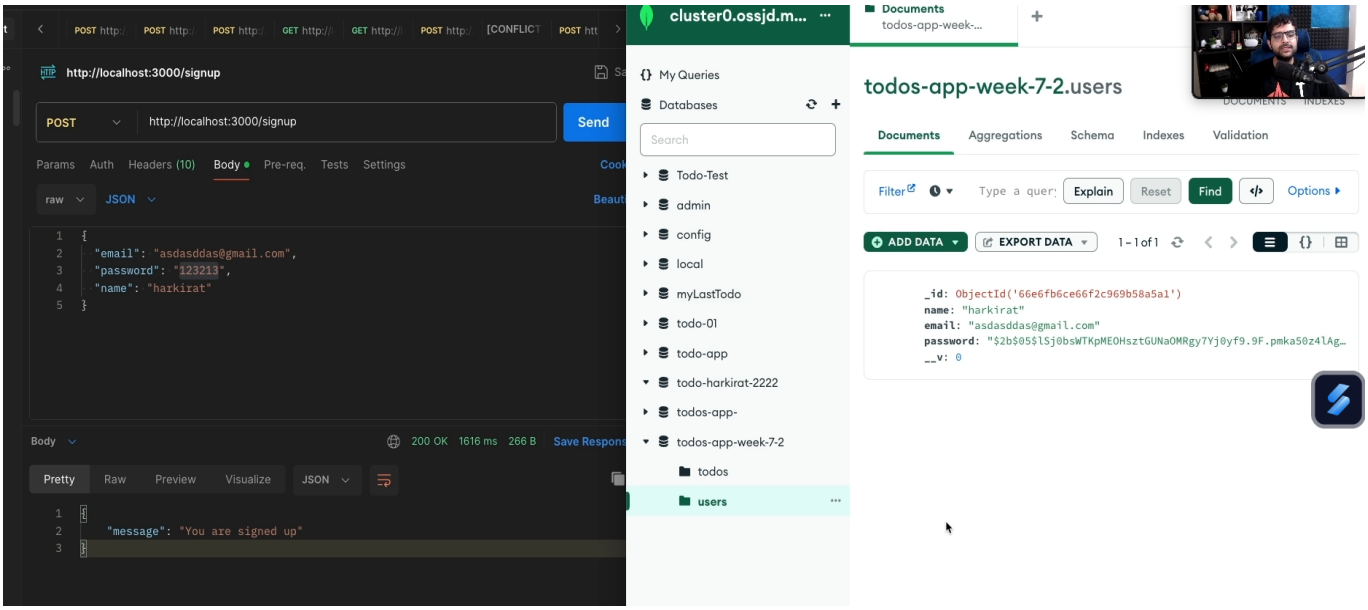
> also you are taking a certain number of rounds(`saltRounds`) to generate the `salt` which will **take time** that's also the main reason to put `await` here
>
> > If you make the second parameter = 0 (i.e. saltRounds = 0), then **no need to write `await` then**

now including it in the `index.js` made

adding it in `"/signup"` endpoint

```
const saltRounds = 10; // gave the number, It simply means how much
computationally heavy you want your password to be (more is better but then takes
a lot of time also then ideally -> 5, 10, 20 (max))

app.post("/signup", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
    const username = req.body.username

    const hashedPassword = bcrypt.hash(password, saltRounds) // called
bcrypt.hash() to hash "password" with "saltRounds" number of rounds

    await UserModel.create({
        email : email,
        password : hashedPassword, // Instead of storing directly the plain text
password, we stored the hashedPassword we got by using the bcrypt.hash() in the
database
        name : username,
    })

    res.json({
        message : " You are signed up "
    })
})
```

You will see the output as



Notice the hashed password it is written in some format

- first *two* -> `$2b` -> means **version of `bcrypt` you are using**
- next *two* -> `$05` -> number of **iterations or saltRounds value**
- and then after this next *sixteen* -> is the `salt`
- and then the *rest* after this is your `password`.

You could have your `salt` independently stored in the database you can do that

Now making changes in the `"/login"` / `"signin"` endpoint

here also two things can happen to verify ->

1. Either you write your **custom logic** to match passwordwhich is like the below
    - **Step 1 -> extract** the `salt` from the database
    - **Step 2 ->** then **Add it** with that(password) given by the user and then at last
    - **Step 3 ->** Implement the **hash** and then **Compare it** with that present in the database

OR

2. use function `bcrypt.compare()`

about `bcrypt.compare()`

takes 2 arguments (its obvious -> jo user ne bhara h (internally isme upar ka process hua and then..)usko compare krega database me jo stored h)

- **value of variable for password in database**
- **value of variable given by the user at the time of sigin**

> ⚠️ `bcrypt.compare()` returns a **Promise** so you **always have to** `await`

```
app.post("/login", async (req, res) => {
    const email = req.body.email
    const password = req.body.password // 1
```

```
    // hit the database to find out user so that .compare() can work as internally
tbhi to ye salt extract kr payega
    const user = await UserModel.find({
        email : email,
        // password : password // no need of this line now as we are checking
password by below method
    })

    if(!user){
        res.status(403).json({
            message : "User does not exist in the database",
        })
        return
    }

    // used bcrypt.compare() to verify
    const passwordMatch = await bcrypt.compare(password, user.password)
    // password is what the user have now gave(value in // 1)
    // and
    // user.password is what in the database where our hashed password exists ??

    if(passwordMatch){
        const token = jwt.sign({
            id : user._id
        },JWT_SECRET)
        res.status(200).json({
            token : token,
            message : "You are logged In"
        })

    }else{
        res.status(403).json({
            message : "Incorrect Credentials",
        })
    }
})
```

Error Handling

This is the **2nd Improvement** of that written in **Improvements which can be made in the above project**

Right now your server will crash if you sign up using duplicate email as you have written this line of code in your file

```
const User = new Schema({
    email : {type : String, unique : true}, // this line means that email should
be unique
    password : String,
```

```
    name : String
})
```

💡 How to avoid that ??

Approach 1 -> **Try - catch**

> 📌 **If you know some part of your code is going to throw error, then you should wrap it in `try-catch`**

so using that in `index.js`

```
app.post("/signup", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
    const username = req.body.username
    try{ // put inside the try catch block
        const hashedPassword = bcrypt.hash(password, saltRounds)

        await UserModel.create({
            email : email,
            password : hashedPassword,
            name : username,
        });

    } catch(e) {
        console.log("User already exists")
    }
    res.json({
        message : " You are signed up "
    })
})
```

But here is the problem now if you will start the server and again `sign up` using already registered email and password then it will although print the "User already exists" in the `console` but the server will show "You are signed up" as that is the `response`

So what if i do like this

```
catch(e) {
        res.json({
            message : "User already exists",
        })
    }
    res.json({
        message : " You are signed up "
    })
```

again this will **crash** the server as

> ⚠️ **You can send only ONE `res` or `response` per route**

so 💡 **How to solve this ??**

There are many ways out of one is like this

```
let errorThrown = false; // made a flag that will trigger only when something is satified

app.post("/signup", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
    const username = req.body.username
    try{
        const hashedPassword = bcrypt.hash(password, saltRounds)

        await UserModel.create({
            email : email,
            password : hashedPassword,
            name : username,
        });

    } catch(e) {
        res.json({
            message : "User already exists",
        })
        errorThrown = true
    }

    if(!errorThrown){
        res.json({
            message : "You are signed up",
        })
    }
})
```

Input Validation

This is the solution to 6th improvement in **Improvements which can be made in the above project**

In **Typescript**, **ZOD** is a library used for schema validation and parsing. Its designed to help developers define, validate, and manage data structure in a type-safe manner

learn more about this library -> ZOD

💡 **What is the need for the above part ??**

If you see your code then

```
app.post("/signup", async (req, res) => {
    const email = req.body.email // string
    const password = req.body.password // string
    const username = req.body.username // string
```

You are expecting from the user that they will give you all these fields in the `String` format but **Should you trust the user when you are making you website ??**

-> **NO**, You should first check the INPUT FIELD that whether it is **Given according to the required input or not** or simply saying **VALIDATE THE INPUT**

some of the examples are

- if `email` is being set -> it should be **string, contains "@", more than 5 letters**
- for `password` it should be -> **Minimum 8 characters, one Uppercase, One special character, etc..**

💡 **How to do the above ??**

Approach 1 -> Either write all thing by yourself (But you have to check a lot of things) like

```
app.post("/signup", async (req, res) => {
    const email = req.body.email
    const password = req.body.password
    const username = req.body.username

    // Input validation (written by yourself)
    if(typeof email !== "string" || email.length < 5 || !email.includes("@")){
        res.json({
            message : "Email not as per the guidelines"
        })
        return
    }
    // similar to this you have to validate PASSWORD

    try{
        const hashedPassword = bcrypt.hash(password, saltRounds)

        await UserModel.create({
            email : email,
            password : hashedPassword,
            name : username,
        });
---------- continued in index.js
```

OR

Approach 2 -> using External library **ZOD**

about ZOD

installing it

```
npm install zod
```

Working with it

Always Remember this ->

> `zod` is a library that is based on **Schema validation approach**

What is schema validation approach ??

what we actually want to be look like our input

something like the below

```
req.body  should look like the below

{
    email : string,
    password : string,
    name : string
}
```

when you know that `req.body` should look like this or **SCHEMA** like this you should first define it but before that `import` it

```
const { z } = require("zod");
```

Step 1 -> Defining the Schema of what your input field should look like and **what it should actually take as Input ??**

```
app.post("/signup", async (req, res) => {

    // Defining the schema
    const requireBody = z.object({ // 2
        email : z.string().min(3).max(100).email(),
        password : z.string().min(3).max(45),
        name : z.string()
    })

    const email = req.body.email
    const password = req.body.password
    const username = req.body.username
```

```
    try{
        const hashedPassword = bcrypt.hash(password, saltRounds)

        await UserModel.create({
            email : email,
            password : hashedPassword,
            name : username,
        });
---------- continued in index.js
```

Explanation of `// 2` code

as we have to make `zod` be used as **OBJECT** so thats why used `.object` and then inside it we have defined the schema of the input field that what it shold take in the **Input field**

- `.string()` checks for the `string` datatype
- `.min()` checks that this much character **MUST** be there
- `.max()` checks that this is **LIMIT** for inserting the character
- `.email()` checks that if it is **EMAIL** or not (i.e consists of "@" symbol or not)

🔶 **You can similarly add hell lot of other checks**

Step 2 -> Parsing the Data or using the above made schema to validate or simply saying **To validate the input**

for this we use two approaches

- `.parse()`
- `.safeParse()`

⚠️ **Remember** Both have Differences (to be discussed later)

but now using them

```
app.post("/signup", async (req, res) => {

    // Defining the schema
    const requireBody = z.object({ // 2
        email : z.string().min(3).max(100).email(),
        password : z.string().min(3).max(45),
        name : z.string()
    })

    // Parsing the schema is Step 2
    // const parsedData = requireBody.parse(req.body); // Ignore this approach for
now
    const parsedDataWithSuccess = requireBody.safeParse(req.body);

    if(!parsedDataWithSuccess.success){ // If the success is not true then input
is not valid
        res.json({
```

```
            message : "Incorrect format",
        })
        return
    }

    // If the above all thing occured correctly then only proceed to store the
Input in the different Variables

    const email = req.body.email
    const password = req.body.password
    const username = req.body.username

    try{
        const hashedPassword = bcrypt.hash(password, saltRounds)

        await UserModel.create({
            email : email,
            password : hashedPassword,
            name : username,
        });
---------- continued in index.js
```

about `.safeParse()`

takes 1 parameter as Input

- **Input** (kahan se input aayega ya lena h??)

Returns 3 things inside 1 OBJECTS

- **success** -> means the validation went correct **No problem**
- **data** -> the output it recieved after validation
- **error** -> what is the problem because of which it did not worked ??

looks something like this

```
{
    success : true | false,
    data : {your data},
    error : []
}
```

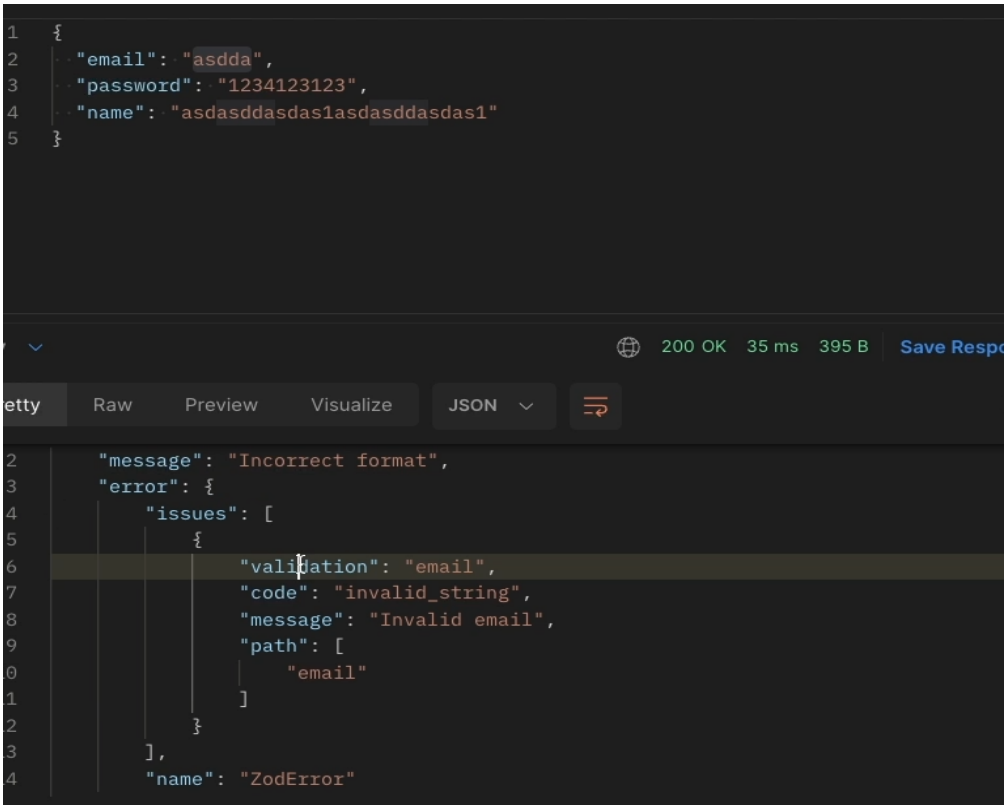
thats why used `parsedDataWithSuccess.success` (as to access the `Object` key we use `.`)

Now the only thing left is to **make the user see what is the mistake they have made ??** i.e. here we are just sending one type of message and that is -> **"Incorrect foramt"** even though they are making mistake in any of the three field given (`email, password, name`)

for this we will use `.error` **which gets returned by** `.safeParse` so just add this section

```
app.post("/signup", async (req, res) => {

    const requireBody = z.object({
        email : z.string().min(3).max(100).email(),
        password : z.string().min(3).max(45),
        name : z.string()
    })
    const parsedDataWithSuccess = requireBody.safeParse(req.body);

    if(!parsedDataWithSuccess.success){ // If the success is not true then input
is not valid
        res.json({
            message : "Incorrect format",
            error : parsedDataWithSuccess.error, // add this line to make the user
know in which input field they made mistake
        })
        return
    }

-------------- continue in index.js
```

This will give something like this



You can see it gave error on the `email` section as you have given wrong `email`(see the email field -> given is "asdaa") and even gave some of the insights to it also similarly if you give password also wrong then **You will get TWO error** and so on

Just show this on the FRONTEND

Now coming to other way used to parse the data or validate the data schema using zod

about `.parse()`

The problem with this is

- **Either it will return the data** if everything is correct
- **Or will throw the error** It will **STOP** the execution
    - so **You must have to put it inside the `TRY-CATCH` block** while using it

Thats why its better to use `.safeParse` as it does not throws `error`, it return the `success` that **Whether it is TRUE or FALSE**

> 📌 `.safeParse()` as the name suggest it **SAFELY PARSE IT**

Assignment

Further improving the validation point

💡 **Lets suppose now in the password you have to fufill this much critera now in the `password` section**

- **at least 2 Uppercase character**
- **at least 1 lowercase character**
- **at least 3 special character**

Then How will you do this by using `zod` ??

for this we use `.regex()`. just as we used `.min(min_length)`, `.max(max_length)` and `.email(email_format_check)` we also have `.regex()`

about `.regex()`

`.regex()` also known as **REGULAR EXPRESSION**

solving the above problem and then understanding what is the syntax of `.regex()` and how it works

we need the below thing to be inserted in the password

- **at least 2 Uppercase character**
- **at least 1 lowercase character**
- **at least 3 special character**

so

```
const requireBody = z.object({
        email : z.string().min(3).max(100).email(),
        password : z.string().min(3).max(45), // instead of this now write this

        password : z.string().min(3).max(45).regex(
  /^(?=(?:.[A-Z]){2,})(?=(?:.[a-z]){1,})(?=(?:.*[^a-zA-Z0-9]){2,})/) // 2
```

```
        name : z.string()
})
```

Explanation of `// 2` code

`/...../` -> known as **Regex Literal** (Everything should be **Inside this**)

`^` -> Anchors the pattern to the **start of string**

`(?=(?:.*[A-Z]){2,})` -> represents condition **at least 2 uppercase letters**

- further explaining its subpart
  - `(?=...)` -> known as **Positive Lookahead ->** means "What follows should must have this sub-pattern (... one)
  - `(?:...)` -> known as **Non - capturing group ->** means space for group logic
  - `.*[A-Z]` -> Any characters (represented by `.*`) between uppercase A-Z
  - `{2,}` -> This entire(the above one) must happen **At least 2 timees** you can also give **At most times** in the space after `2,here you can give max`

`(?=(?:.*[a-z]){1,})` -> same as the above just here you are defining that **At least** one should be between lowercase (a-z) this range

similarly

`(?=(?:.*[^a-zA-Z0-9]){2,})` -> same as the above but here the part

- `^a-zA-Z0-9` -> means `^` **NOT** means take anything BUT dont take these -> `a-z`(lowercase) or `A-z`(uppercase) or `0-9`(Numbers) Indirectly **Take only special character**